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N^o. XV.

Description of a Machine for saving Persons from the upper Stories of a House on fire, by NICHOLAS COLLIN, D. D. the Inventor ; with a Drawing from the Model.

Read Nov. 7
4, 1791. } ABCC is a trunk with a socket from top to bottom, and two pulleys *a, a* in the sides C, C. In this the cylindrical shaft DE moves, supported on the pulleys by two ropes. These are by one end tacked to the foot of the shaft, and by the other to the axes of the windlasses I, I, which stand below. The cranks, winding the ropes round the axes, lift the foot of the shaft to the pulleys, and by unwinding let it down to the bottom.

FEG is a lever, turning on its fulcrum, which is fixed in the top of the shaft, by the iron tire *d*. The long arm is pressed by the frame at its end: the short one is held in balance by the rope GH, which is fastened on the base of the machine. As the lever descends with the shaft, the rope slackens on the short arm; then the other, no longer balanced, descends round the fulcrum, and by this motion turns the short one upwards tight against the rope. Their angular contrary movements continue thus, until the shaft reaches the bottom of the socket; and the basket at the same time comes to the ground.

The base is a rectangular plank floor with a compact frame underneath. The trunk is fixed in it, by several bracers *c*, and other usual fastening, both above and below, standing somewhat from the centre towards the rope GH, in order to counteract its raising that end.

The windlasses are firmly set in the floor, near the trunk, directly under the pulleys.

The wheels are low and strong, placed near the corners of the base. They have locks, to be used when the machine is loading.

The basket is breast-high, and wide enough for four persons. The three iron rods keep it more steady than cords would; and their openings admit one person at a time. It hangs free from the end of the lever.

The principles of this construction arise from the requisite properties of this machine: It must be speedily brought; readily fitted; practicable in confined places; want no support from the wall; reach a considerable height, and also project over obstacles on or above the ground; take down several persons at once, and without any exertion of theirs. The two vertical pieces folded, with the lever oblique, can both be housed and easily carried: when put in action, they expand gradually; and the lever is high when at full length. The base may be convenient, because its own weight, with the trunk and the four men at the windlasses keep the centre of gravity pretty low; and all the pressures bear perpendicular on the longer face. Besides, people may sit down on the sides, or hold it by handspikes, which may be kept on it, and when wanted, put into holes near the margins, so as to project outwards.* A level position being very necessary, a plumb rule should also be hung on the trunk.

The cylindrical form of the shaft and socket procures an easy gliding motion, that lessens the occasional sideway bearings. It is also less alterable by wear, and change of weather; it makes the shaft more solid, and thus requires less bulk in both pieces. The two quarters of the trunk which are slit for a communication of the ropes with the shaft, will yet be strong enough by the solid piers that bear the pulleys. The other two have

* It is wider on the model than it appears under an oblique perspective.

sufficient

sufficient firmness against oblique pressures, arising from the action of the machine, or from the casual inclination of the base. The part from the brim to the pulleys inclusively is fortified by the iron-band BB, to secure the shaft when drawn up. The height of that piece, its own weight, the pressure on its head, and the obliquity of the same at the time, together with probable external accidents, will determine the width; it need perhaps not exceed a fifth of the part below.

The trunk and shaft require stiff and hard materials. The lever being made of tough wood, may be further strengthened by iron plates. The solidity and shape of the fulcrum and arms must be carefully proportioned to their respective weights.

The shaft, when down, reaches beyond the trunk so much as to clear the lever of the piers. This added to the distance of the brim from the pulleys, is the difference between the shaft and their height aa . The altitude aE is therefore aa doubled and that surplus. If the shaft bore a greater proportion in effecting this altitude, it must be longer; consequently it would, when standing, hold the arm further from the ground, and render that piece, with itself, less portable; and, when up, increase the weight on the fulcrum, and the pressure against the socket.

The arm EF rises from aE on an angle about fifty degrees with the horizon, thus making a good projection, and a considerable increase of altitude. Its proportion to the shaft, and angle with it when down, are such as to set the basket on the ground.

These angles, the shaft, and the space aa (its elevation), accord in adjusting the proportion of EG, and the position of the rope. When the lever descends the arm EG opens, and throws out the rope, keeping it stretched all the while. This makes it describe a circular arch.

arch. The lever having come to a horizontal position, the arm by the continued rotation returns towards the line aE , and makes the rope retrace the arch until the shaft is down. If the reversed angle of the arm is then equal to aEG , the rope comes to the point G from whence it went, if less it goes beyond. In the first case EG is the side of a triangle which has aa for its base and two angles equal to aEG ; in the second it is less than this side. As the elevation of EF is not above 50, its complement aEG (40) is greater than the angle of EF with the shaft, which with that span would hold the arm too high from the ground. It consequently exceeds the reversed angle which (being opposite) is equal with this. Therefore the short arm is less than the said side, but the difference is not great.—The situation of the shaft being most critical in the highest elevation, the rope should then allow the lever very moderate rotation, and thus lessen the kicking of the weight against the fulcrum. Its position will therefore be nearly perpendicular, when the descent begins, that the arch, immediately falling, or rising very little, may keep down the end of EG . This position requires a moderate elevation of EF ; for if the angle DEG is too contracted, EG will project far beyond the foot of the rope, in and about its horizontal passage, and thus produce a detrimental obliquity. It also limits the fall of EF , by regulating the reversed angle; for the nearer the point G returns to the shaft, the further it goes from the rope, and the more oblique is the outward draught.

The obliquity of draught admitted in this machine, appears easy on the model: trials may prove a greater elevation of the lever practicable. The proportion of the short arm is sufficient while the whole weight to be wound up does not exceed that of twelve persons; for so much, at least, four hands at the windlasses are competent.

petent. If the rope is drawn by hands, this arm must still, for the sake of convenient carriage, be much shorter than the other ; and accidents of mismanagement might happen, which the fixed rope prevents: it is prudent to entrust the machine with all the powers it can exercise ; especially as it must be used on the dismal occasion of nocturnal incends.

In considerable towns the houses differ so much in height, that machines of two sizes are necessary. The larger should be competent for the third or fourth stories in the highest buildings, according to their dimensions, and the practicable size of the three pieces ; and the smaller for those in the lowest. As both have several degrees of elevation, they will also suit inferior stories respectively, and thus take in all the different heights. The basket must ascend so near beneath the window, that the persons may, without fear, get in, and descend so low that they may get out. For the last the arm cannot be long enough, when great altitudes demand very high shafts ; then a rope ladder may be fixed on the basket, and let down when the machine stops ; ten feet from the ground, if necessary. As the dimensions of the lever and shaft of large machines demand great solidity, their weight will bear a considerable proportion of the whole that is wound up. One or two persons the more in the basket would proportionally less increase the whole. Their bases will also be wide enough for two men at each of the four cranks. The smaller machines must support the weight of four full-grown persons, as the fire may prevent a second going up. Their bases are to be fitted for narrow alleys, and crowded places.

Much property might be saved from the fire by machines of a similar construction with this, having a capacious basket, and capstans instead of windlasses. The combination

combination of perpendicular and lateral movements may also be applied to many other valuable purposes.

Perpendicular lines being dropt from the point G to the base, the squares of these, and the squares of the distances of their ends from the foot of the rope, are jointly equal to the square of the rope. The square of EG is likewise equal to those of its sines. When the shaft is drawn up, the perpendicular height of the rope differs from the joint heights of the shaft and pulleys by the cosine of DEG; and when the shaft is down, it is equal to the height of this piece, joined to the cosine of the reversed angle. The sines of these angles are equal to the distances between the ends of the said perpendiculars and the center of the trunks bottom. Taking the value of the rope in the two cases, gives this equation: $aa^2 + 2\text{shaft.} \times aa =$

$$\begin{aligned} &2aE \times \cos. DE \\ &+ 2fb \times \cos. \text{rev. ang.} \\ &+ 2aH \times \sin. DEG - \sin. \text{rev. a.} \end{aligned} \left. \vphantom{\begin{aligned} &2aE \times \cos. DE \\ &+ 2fb \times \cos. \text{rev. ang.} \\ &+ 2aH \times \sin. DEG - \sin. \text{rev. a.} \end{aligned}} \right\} EG.$$

This will guide the choice of angles, proportion of EG, and position of the rope.

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